How Can We Realize Wood Product Substitution Benefits?

CCFM E-Lecture Series

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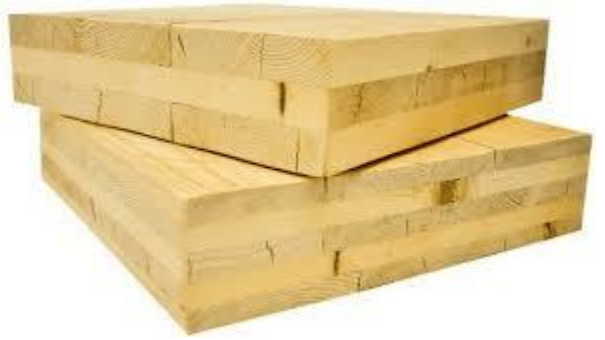
- Background
- Overview of four main assumptions:
  - Changes in harvest or production rates will lead to a corresponding change in wood product consumption
  - Wood building products are substitutable for concrete and steel
  - The same mix of products could be produced from increased harvest rates of a given area
  - There are no market responses to increased wood use
- Conclusions

- The current construction industry is dominated by steel, cement, paper, plastics, and aluminum, accounting for about 7% of global CO_2 emissions

- Carbon dioxide (CO_2) can potentially be reduced by using wood products in the construction sector

- The climate benefits of using wood come from the:

  - Low fossil fuel energy needed for wood product manufacture
  - Avoidance of industrial emissions related to non-wood product manufacture
  - Potential to use waste wood for bioenergy
  - And, the actual carbon stored in wood products



- Given this information, we need to decide when forests are better left unharvested or harvested to supply materials to replace concrete and steel in construction
- One of the decision tools that can help us make this choice is a wood product substitution benefit of a particular product, measured as a displacement factor
- Often used to model wood product benefits, displacement factors express the efficiency of using particular wood products to substitute for non-wood products, in kg carbon avoided per kg carbon wood product used
- The average displacement factor for wood products is:

1.2 kg C of emissions reduction

per

1 kg C of wood product used

- The use of displacement factor methodology within climate change mitigation related research papers leads to considerations of how the substitution benefit calculated can be actualized

- A number of assumptions underlie the use of this methodology, and in an effort to determine these assumptions, we reviewed current literature focussed on wood use in the construction industry

- Four major assumptions used when applying substitution factor methodology include:

  - Changes in harvest or production rates will change wood product consumption
  - Wood building products are substitutable for concrete and steel
  - The same mix of wood products could be produced from increased harvest rates
  - There are no market responses to increased wood use

« Changes in harvest or production rates will lead to a corresponding change in wood product consumption, as well as an opposite response in concrete, steel, or fossil fuel use. »

- A basic assumption underlying the use of displacement factors is often that increasing the supply of primary wood will increase the overall consumption of wood products
- Economic theory tells us that an increase in supply of primary wood would lead to increased wood product purchases, when all other factors affecting wood product demand remain unchanged
- There is some evidence that increased harvest will increase consumption of wood products, but there are limited studies that show this relationship empirically

- There is the additional issue of leakage:
  - Harvest leakage refers to when restricted harvest rates in one region cause increases in harvest rates in another region
- Many model based papers investigating the effects of wood based construction automatically include an assumed leakage rate, indicating that forest product demand is not the only factor influencing harvest rates
- Many paper authors acknowledge that they are aware that forests will not be perfectly sustainably managed

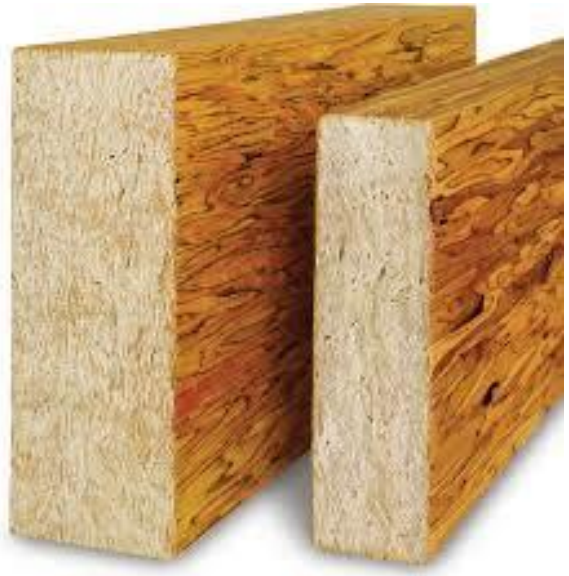
In order to actualize the calculated substitution benefits in the Canadian forest sector:

- Canada's forests are at a generally low risk of leakage, due to public ownership and being inaccessible to economic exploitation
- In order to increase harvest rates in Canada, a push to create more long-lived wood products would have to be associated with policies that increase forest harvest at the intensive margin
- More research and publications demonstrating a direct relationship between harvest rates and use of wood products would help confirm the benefit of climate change mitigation studies examining increased wood products as a strategy of interest

« Wood building products are substitutable for concrete and steel. »

- While wood products are likely a better option than steel or concrete in the construction sector, it is unclear how substitutable current or future wood-based designs are for current typical building design

- Substitutability is influenced by:
  - Technical properties of wood
  - Product price
  - Acceptance of new building materials
  - Regulation of new products
  - Education of industry stakeholders



- Building types and blueprints will likely have to be changed in order for the share of wood products in the construction sector to increase
- Products like wood fibre insulation boards, cross-laminated timber, laminated veneer lumber, and glulams have properties similar to traditional fossil-fuel based products currently used in the construction sector
- However, these products may only be able to enter the construction sector when they become economically competitive with traditional products
- Concrete and steel are institutionally locked in, therefore in order to actualize the substitution benefit of wood products, we need to acknowledge that the adoption of these products into the current construction industry may be difficult, or delayed

In order to actualize the calculated substitution benefits in the Canadian forest sector:

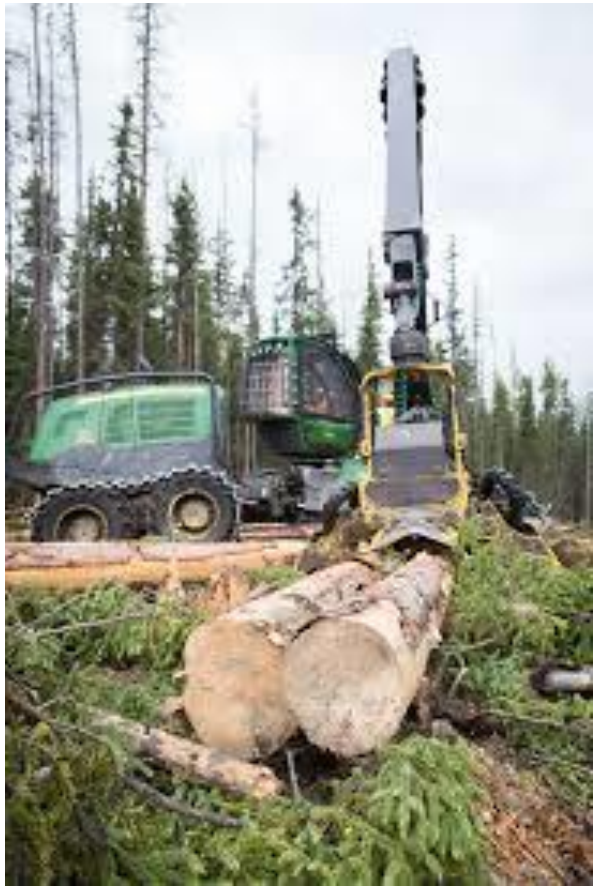
- A great example of wood products in the Canadian forest sector is the Brock Commons building on the UBC Vancouver campus, made with CLT, GLT, and PSL
- This building performs better when compared to traditional reinforced concrete structure, however, it is about 7% more expensive per square meter
- Increasing education of the suitability of wood products for these tall buildings will be integral in increasing their construction in the Canadian context
- Amid increasing pest infestations and forest fires in Western Canada, it will be important to maintain and achieve the necessary CLT production

« The same mix of products could be produced from increased harvest rates of a given area. »

- Some analyses that use displacement factors to calculate wood product substitution benefits test climate change mitigation strategies that involve increased utilization of forest resources to provide additional long-lived wood products
- This assumption requires no additional area of forest to be harvested, but it does assume that more volume of products can be produced from the area already harvested
- Generally, forests can produce a given percentage of long-lived products along with a given percentage of short-lived products, which are mutually exclusive
- For example, in Canada, about 1/3 of wood products are long-lived

- The following need to be considered before a stand is considered to be suitable for contributing to the production of long-lived products:
  - Tree species
  - Timber diameter
  - Quality of carbon storage
  - Thinning requirements

- Sawlog and pulpwood harvests are not directly substitutable, therefore, managers need to consider the following management choices to help make forests more applicable for long-lived product production:
  - Increasing rotation times
  - Increasing basal area
  - Evaluating the quality of the wood being grown



In order to actualize the calculated substitution benefits in the Canadian forest sector:

- Policy makers need to ensure that they are supporting forest management pathways focussed on increasing forest utilization and long-lived wood products
- Focus should be placed on how to use lower quality or smaller trees to produce engineered wood products, such as CLT
- Technical support needs to be given to the forest industry to provide guidance for the mass production of these engineered products, and there needs to be an internal push to harvest less valuable, but smaller, underutilized trees
- A wide sweeping carbon tax may be helpful to avoid burning harvest residues that could otherwise be used to create engineered products

« There are no market responses to increased wood use. »

- If a wooden building is constructed, assumptions within current research suggest that the avoided concrete and steel emissions are not released elsewhere
- However, cross-sectoral leakage could occur, and the concrete and steel could be used somewhere else, instead of being completely avoided
- We have not been able to find studies on cross-sectoral leakage in the construction industry
- In more broad economic studies, climate mitigation policies that are only applied to a subset of jurisdictions result in emissions being shifted to other jurisdictions

In order to actualize the calculated substitution benefits in the Canadian forest sector:

- From a Canadian perspective, a common methodological timeline to adopt when considering permanent avoidance of emissions is 100 years
- A potential solution is to weight future carbon fluxes by determined urgency associated with the need to address climate change
- The likelihood of a wooden building being used to generate energy at the end of its lifetime is also important, as reemission of carbon may be less of an issue with continued development of carbon capture and storage technology

- Many studies assessing forest management or products for climate change mitigation depend on a suite of assumptions
- Ignoring or misunderstanding these assumptions could result in decreased actualized avoided emissions, when compared with the original displacement factor suggested in original analyses
- We have suggested a number of broad policy considerations that could help reduce the uncertainty of actualizing substitution benefits of using wood products in the construction sector
- Overall, the use of wood construction products can be supported by governments committing to global climate change action that includes the forest sector, applying sweeping carbon taxes, and implementing programs that increase wood product awareness

I gratefully acknowledge the contributions of my coauthors:

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